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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/815,842	04/02/2004	Hui-Chi Su	BHT-3111-451	9696

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EXAMINER	
MARKHAM, WESLEY D	
ART UNIT	PAPER NUMBER
1762	

DATE MAILED: 04/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/815,842	SU ET AL.	
	Examiner	Art Unit	
	Wesley D. Markham	1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 March 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) *11-21* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 April 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of Group I, **Claims 1 – 10**, drawn to a method for assembling carbon nanotubes (CNTs), in the reply filed on 3/6/2006 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Claims 11 – 21 are withdrawn from further consideration by the examiner as being drawn to a non-elected invention. An Office action on the merits follows.

Priority

2. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d) (the certified copy of TAIWAN patent application 93101013, filed on 1/14/2004), which papers have been placed of record in the file.

Drawings

3. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: "43", "44", and "131" in Figure 1. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement

drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The disclosure is objected to because of the following informalities:
    - Page 1, line 16: A period is missing after the word "heat".
    - Page 2, line 6: The word "assembly" appears to by a typographical / grammatical error and should read "assemble".
    - Page 6, line 2: A period is missing after the word "position".

Appropriate correction is required.

Claim Objections

5. Claims 1, 4, and 7 are objected to because of the following informalities:
    - Claim 1, line 2: The word "the" is missing between the words "comprising" and "following".
    - Claim 1, lines 3 and 5: The phrases "an substrate" and "an tip" contain typographical errors and should read "a substrate" and "a tip", respectively.

- Claim 1 is missing a period at the end of the claim.
- Claim 4, line 3: The word "portion" is misspelled "potion".
- Claim 7, lines 2 – 3: The word "the" is missing between the words "comprises" and "following".
- Claim 7, second to last line: The word "layer" is missing after the word "conductive".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 2, and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by Chin et al. (JP 2002-301700 A).
8. Regarding independent **Claim 1**, Chin et al. teaches a method for assembling CNTs and microprobes (Abstract, paragraphs [0001], [0005], [0010], and [0021]), comprising forming at least one microprobe "10", "21" (Abstract, Figures 1 and 3,

paragraphs [0010], [0011], [0013], and [0020]) on a substrate (e.g., the cantilever shown in Figure 1 or the electrode holders "20" shown in Figure 3), the microprobe being covered by a conductive layer (paragraphs [0013] and [0014]); exposing a tip "11", "21" of the microprobe to a solution "13" having CNTs spreading therein, the solution being furnished with an electrode "12", "22" (Figures 1 and 3; paragraphs [0011] – [0021]); and applying a predetermined voltage between the conductive layer and the electrode, making at least one CNT "14" move and attach onto the tip of the microprobe (Figures 1 – 3; paragraphs [0011] – [0021]). Regarding **Claim 2**, Chin et al. also teaches that the surface area of the electrode "12", "22" exposed to the solution is larger than the tip of the microprobe "11", "21", which is small enough to function as an AFM tip (Figures 1 and 3; paragraph [0013]). Regarding **Claim 5**, the substrate is made of silicon (paragraphs [0003], [0013], and [0014]).

9. Claims 1, 2, 5, 6, and 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Han et al. (US 2004/0211271 A1).

10. Regarding independent **Claim 1**, Han et al. teaches a method for assembling CNTs and microprobes (paragraphs [0002] – [0008], [0022], [0042], and [0043]), comprising forming at least one microprobe "400" on a substrate "300" (Figures 2, 5a, 5b; paragraphs [0002], [0035] – [0054]), the microprobe being covered by a conductive layer (paragraph [0036]); exposing a tip of the microprobe to a solution "200", "200-1" having CNTs spreading therein, the solution being furnished with an electrode "100" (Figures 2, 5a, 5b; paragraphs [0002], [0035] – [0054]); and applying

a predetermined voltage between the conductive layer and the electrode, making at least one CNT move and attach onto the tip of the microprobe (Figures 2, 5a, 5b; paragraphs [0002], [0035] – [0054]). Regarding **Claim 2**, Han et al. also teaches that the surface area of the electrode exposed to the solution is larger than the tip of the microprobe, which is small enough to function as an AFM tip (Figures 2, 5a, 5b; paragraphs [0036] – [0043]). Regarding **Claims 5 and 6**, Han et al. teaches that the substrate is made of silicon and the microprobe is formed on the substrate using "micro-machining" (i.e., "semiconductor processing") (paragraphs [0002], [0004], [0005], [0036], [0042], and [0043]). Regarding **Claim 10**, Han et al. teaches that the solution is isopropyl alcohol (IPA) (paragraph [0036]).

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order

for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

13. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of either Choi et al. (USPN 6,616,497) or Takai (USPN 6,911,767).

14. Chin et al. teaches all the limitations of **Claim 3** as set forth above in paragraph 8, except for providing ultrasonic oscillation to the solution for preventing the CNTs from gathering together. However, both Choi et al. (Col.4, lines 21 – 31) and Takai (Col.6, line 66 – Col.7, line 3) teach sonicating the CNT solution during an electrophoretic deposition process (i.e., a process analogous to that of Chin et al.) to positively or negatively charge the CNTs. Therefore, it would have been obvious to one of ordinary skill in the art to provide ultrasonic oscillation to the CNT solution of Chin et al. in order to reap the benefits taught by Choi et al. or Takai (i.e., charging the CNTs, thereby allowing the charged CNTs to preferentially migrate to the electrode having the opposite charge in the CNT solution). Such a sonication process would have inherently prevented the CNTs from gathering together (i.e., because the high frequency vibration would thoroughly mix the CNTs and the solvent in the solution), as claimed by the applicant.

15. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of Sheu et al. (US 2003/0049875 A1).

16. Chin et al. teaches all the limitations of **Claim 4** as set forth above in paragraph 8, except for covering the conductive layer except for the tip portion of the microprobe with a non-conductive material. However, it is the goal of Chin et al. to attach a CNT to the tip of the microprobe (Figure 2; paragraphs [0011], [0012]). Sheu et al. teaches that, in the art of depositing CNTs onto a conductive material pattern by electrophoresis, it is desirable to deposit a sacrificial layer "78" made of, e.g., a photoresist (i.e., a "non-conductive material") onto the portions of the substrate where CNT deposition is not desired, thereby preventing CNTs from depositing on undesired locations (paragraphs [0043] – [0049]). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a sacrificial photoresist layer such as that taught by Sheu et al. onto portions of the conductively-coated microprobe of Chin et al. where CNT deposition is not desired (i.e., all of the microprobe except for the tip), with the reasonable expectation of successfully and advantageously preventing CNT deposition on undesired portions of the microprobe of Chin et al. (i.e., all portions but the tip), thereby achieving the goal of Chin et al. of depositing a CNT on the tip of the microprobe.

17. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of Albrecht et al. (USPN 4,968,585).

18. Chin et al. teaches all the limitations of **Claims 5 and 6** as set forth above in paragraph 8, except for forming a microprobe on the substrate using semiconductor processing, the substrate being silicon. Specifically, Chin et al. is silent regarding

how the microprobes are fabricated. However, Chin et al. does teach that the microprobe can be a probe conventionally used as a STM and AFM tip and is made of a material such as Si or silicon nitride (paragraphs [0013] and [0014]). Albrecht et al. teaches a method of making AFM tips by semiconductor processing, the substrate and tips being made of Si or silicon nitride (Col.1, lines 13 – 20, Col.2, line 55 – Col.3, line 20). The process produces tips that are uniform, sharp, well-formed, durable, and inexpensive (Col.2, lines 55 – 62). Therefore, it would have been obvious to one of ordinary skill in the art to form the microprobe of Chin et al. from the materials (e.g., Si, SiN) taught by Albrecht et al. and by the process of Albrecht et al. (i.e., a "semiconductor" process) with the reasonable expectation of (1) success, as Chin et al. teaches that conventional STM and AFM probe tips are used in the CNT attachment process, and (2) obtaining the benefits taught by Albrecht et al., such as producing a tip that is uniform, sharp, well-formed, durable, and inexpensive.

19. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of Albrecht et al. (USPN 4,968,585) and Sheu et al. (US 2003/0049875 A1).

20. The combination of Chin et al. and Albrecht et al. teaches all the limitations of **Claims 7 and 8** as set forth above in paragraph 18, except for a method further comprising forming a non-conductive layer covering the conductive layer except for the portion of the conductive layer covering the tip of the microprobe. Please note

that Albrecht et al. teaches the claimed process steps for producing a silicon or silicon nitride microprobe on the substrate (Col.3, lines 6 – 20, Col.3, line 65 – Col.4, line 47), and Chin et al. teaches forming a conductive layer on the substrate covering at least the tip of the microprobe (paragraphs [0013] and [0014]). Additionally, it is the goal of Chin et al. to attach a CNT to the tip of the microprobe (Figure 2; paragraphs [0011], [0012]). Sheu et al. teaches that, in the art of depositing CNTs onto a conductive material pattern by electrophoresis, it is desirable to deposit a sacrificial layer "78" made of, e.g., a photoresist (i.e., a "non-conductive material") onto the portions of the substrate where CNT deposition is not desired, thereby preventing CNTs from depositing on undesired locations (paragraphs [0043] – [0049]). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a sacrificial photoresist layer such as that taught by Sheu et al. onto portions of the conductively-coated microprobe of Chin et al. where CNT deposition is not desired (i.e., all of the microprobe except for the tip), with the reasonable expectation of successfully and advantageously preventing CNT deposition on undesired portions of the microprobe of Chin et al. (i.e., all portions but the tip), thereby achieving the goal of Chin et al. of depositing a CNT on the tip of the microprobe.

21. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of Zhou et al. (US 2003/0102222 A1) and Takai (USPN 6,911,767).

22. Chin et al. teaches all the limitations of **Claim 9** as set forth above in paragraph 8, except for including an anionic surfactant capable of attaching a layer of negative charges onto the surface of the CNTs and connecting the conductive layer (the microprobe tip) to the positive of a predefined power supply. However, Zhou et al. teaches that, in the art of depositing CNTs by electrophoresis, it is desirable to add a "charger" material to the solution to impart either negative or positive charges to the CNTs in solution, thereby preferentially attracting the CNTs to either the positive electrode (cathode) or negative electrode (anode) (paragraphs [0080] – [0083] and [0088]), and Takai teaches that anionic surfactants are examples of such charger materials that are used in CNT electrophoretic deposition (Col.6, lines 56 – 67). Therefore, it would have been obvious to one of ordinary skill in the art to add a negative charger material such as an anionic surfactant to the CNT solution of Chin et al., as taught by the combination of Zhou et al. and Takai, and to attach the conductive layer on the microprobe tip to the opposite charge of the power supply (e.g., the positive terminal when a negative charger is used in the solution) in order to reap the benefit of charging the CNTs (i.e., preferentially attracting the CNTs to the microprobe tip in the CNT solution due to the opposite charges).

23. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chin et al. in view of Nakayama et al. (USPN 6,528,785).

24. Chin et al. teaches all the limitations of **Claim 10** as set forth above in paragraph 8, except for using IPA as the solvent in the CNT solution. Specifically, Chin et al.

teaches that the liquid is not limited and can be an alcohol such as MeOH, EtOH, etc. (paragraph [0015]). Nakayama et al. teaches that, in the art of electrophoretically depositing CNTs onto a substrate, the solvent should be capable of dispersing the CNTs and is, for example, EtOH, IPA, etc. (Col.10, lines 45 – 62). In other words, Nakayama et al. teaches the functional equivalence of IPA and other alcohols such as EtOH in the art of dispersing CNTs for electrophoretic deposition. Therefore, it would have been obvious to one of ordinary skill in the art to use IPA as the solvent in Chin et al. with the reasonable expectation of success and obtaining similar results (i.e., successfully dispersing the CNTs, regardless of whether EtOH or IPA is used as the dispersion medium).

25. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. in view of either Choi et al. (USPN 6,616,497) or Takai (USPN 6,911,767).

26. Han et al. teaches all the limitations of **Claim 3** as set forth above in paragraph 10, except for providing ultrasonic oscillation to the solution for preventing the CNTs from gathering together. However, both Choi et al. (Col.4, lines 21 – 31) and Takai (Col.6, line 66 – Col.7, line 3) teach sonicating the CNT solution during an electrophoretic deposition process (i.e., a process analogous to that of Han et al.) to positively or negatively charge the CNTs. Therefore, it would have been obvious to one of ordinary skill in the art to provide ultrasonic oscillation to the CNT solution of Han et al. in order to reap the benefits taught by Choi et al. or Takai (i.e., charging the CNTs, thereby allowing the charged CNTs to preferentially migrate to the

electrode having the opposite charge in the CNT solution). Such a sonication process would have inherently prevented the CNTs from gathering together (i.e., because the high frequency vibration would thoroughly mix the CNTs and the solvent in the solution), as claimed by the applicant.

27. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. in view of Sheu et al. (US 2003/0049875 A1).

28. Han et al. teaches all the limitations of **Claim 4** as set forth above in paragraph 10, except for covering the conductive layer except for the tip portion of the microprobe with a non-conductive material. However, it is the goal of Han et al. to attach a CNT to the sharp tip of the microprobe (Abstract, paragraphs [0042] and [0043]). Sheu et al. teaches that, in the art of depositing CNTs onto a conductive material pattern by electrophoresis, it is desirable to deposit a sacrificial layer "78" made of, e.g., a photoresist (i.e., a "non-conductive material") onto the portions of the substrate where CNT deposition is not desired, thereby preventing CNTs from depositing on undesired locations (paragraphs [0043] – [0049]). Therefore, it would have been obvious to one of ordinary skill in the art to deposit a sacrificial photoresist layer such as that taught by Sheu et al. onto portions of the conductively-coated microprobe of Han et al. where CNT deposition is not desired (i.e., all of the microprobe except for the tip), with the reasonable expectation of successfully and advantageously preventing CNT deposition on undesired portions of the microprobe of Han et al.

(i.e., all portions but the tip), thereby achieving the goal of Han et al. of depositing a CNT on the tip of the microprobe.

29. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Han et al. in view of Zhou et al. (US 2003/0102222 A1) and Takai (USPN 6,911,767).

30. Han et al. teaches all the limitations of **Claim 9** as set forth above in paragraph 10, except for including an anionic surfactant capable of attaching a layer of negative charges onto the surface of the CNTs and connecting the conductive layer (the microprobe tip) to the positive of a predefined power supply. However, Zhou et al. teaches that, in the art of depositing CNTs by electrophoresis, it is desirable to add a "charger" material to the solution to impart either negative or positive charges to the CNTs in solution, thereby preferentially attracting the CNTs to either the positive electrode (cathode) or negative electrode (anode) (paragraphs [0080] – [0083] and [0088]), and Takai teaches that anionic surfactants are examples of such charger materials that are used in CNT electrophoretic deposition (Col.6, lines 56 – 67). Therefore, it would have been obvious to one of ordinary skill in the art to add a negative charger material such as an anionic surfactant to the CNT solution of Han et al., as taught by the combination of Zhou et al. and Takai, and to attach the conductive layer on the microprobe tip to the opposite charge of the power supply (e.g., the positive terminal when a negative charger is used in the solution) in order to reap the benefit of charging the CNTs (i.e., preferentially attracting the CNTs to the microprobe tip in the CNT solution due to the opposite charges).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Zhou et al. (USPN 7,014,743) teaches using electrophoretic deposition to attach a CNT to the tip of a microprobe or an array of microprobes.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D. Markham whose telephone number is (571) 272-1422. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tim Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER

Wesley D Markham
Examiner
Art Unit 1762

WDM